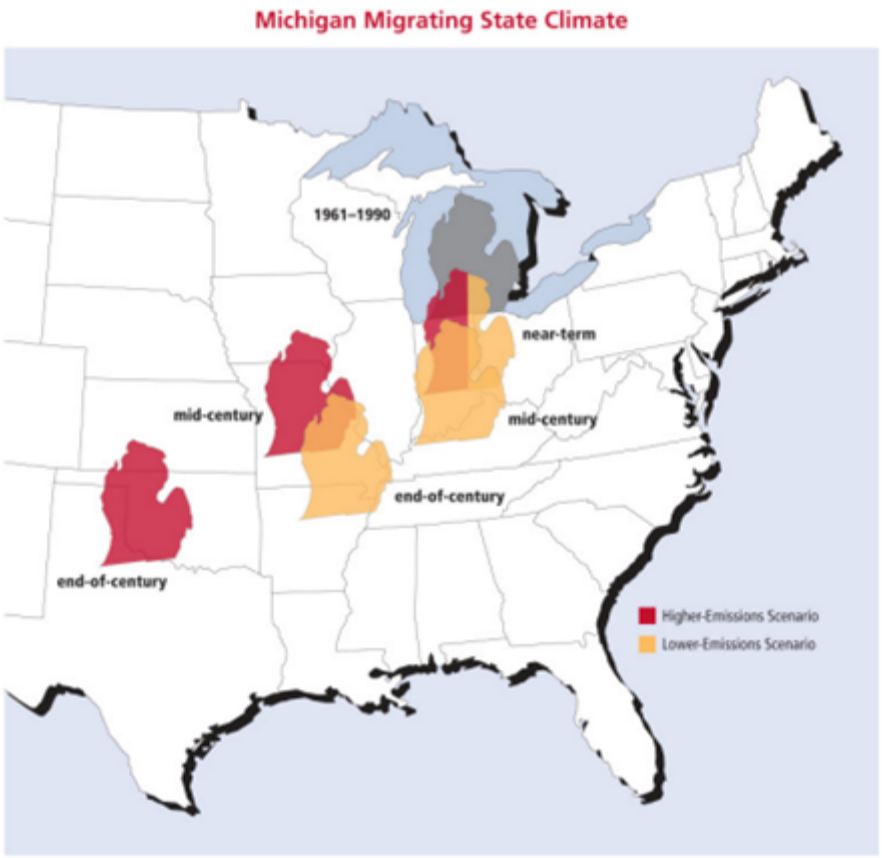
The Future of Midwest Invasive Plants

One of the many anticipated, and to some extent already observable impacts of environmental change is that plants in the Northern Hemisphere, including invasive plants, are likely to shift their ranges northward. Almost all terrestrial plants are rooted in place for life, so these range shifts happen over generations. Milder winters and higher minimum winter temperatures allow less hardy plants to potentially germinate seed and survive to maturity further north than they have previously. Some species may need to move north or to higher elevations to escape unsurvivable summer heat in southern areas. Changes in precipitation patterns are also likely to play an important but less predictable role in future habitat suitability. Species associated with long-distance spread pathways, including dispersal by migratory birds, movement in running water, and human-aided transport, are likely to migrate more quickly than those that are not.

Gardeners are used to thinking about the geographic bounds where plants can survive in terms of USDA Plant Hardiness Zones, which are defined by the minimum winter temperature expected at a particular location. Under environmental change, the zones as we know them are likely to shift northward. Click for the USDA's interactive map of current Hardiness Zones, last updated in 2023.

Although there is no similar high-resolution tool to view expected future zones, the image below, cropped from a 2018 US Forest Service report (pdf), shows how zones may shift by mid-century in response to changes under a moderate emissions scenario. By mid-century, we might expect the southern half of Missouri, southern thirds of Illinois and Indiana, most of Ohio, the Toronto area, and the near-shore areas of Michigan's Lower Peninsula to be in Zone 7. The rest of Missouri, Illinois, Indiana, and Ohio will be in Zone 6, as will the eastern Wisconsin lakeshore, southern Iowa, the eastern half of Michigan's Upper Peninsula, most of the inland Lower Peninsula, and southern Ontario. Minnesota will be in Zone 5 south of the Twin Cities, as will northern Iowa, the southern two thirds of Wisconsin, the western half of the UP and a small area in the central-northern LP. Most of northern Minnesota and the northern third of Wisconsin will be in Zone 4, as will Ontario from Thunder Bay to Ottawa. Only Minnesota's far north, along the Canadian border, and central Ontario will be colder than Zone 4.



Michigan Migrating State Map: Depending on greenhouse gas emissions, Michigan's Lower Peninsula could start feeling like the Ozarks, or even Western Oklahoma, by 2100. *https://www.ucs.org/sites/default/files/2019-09/midwest-climate-impacts.pdf*

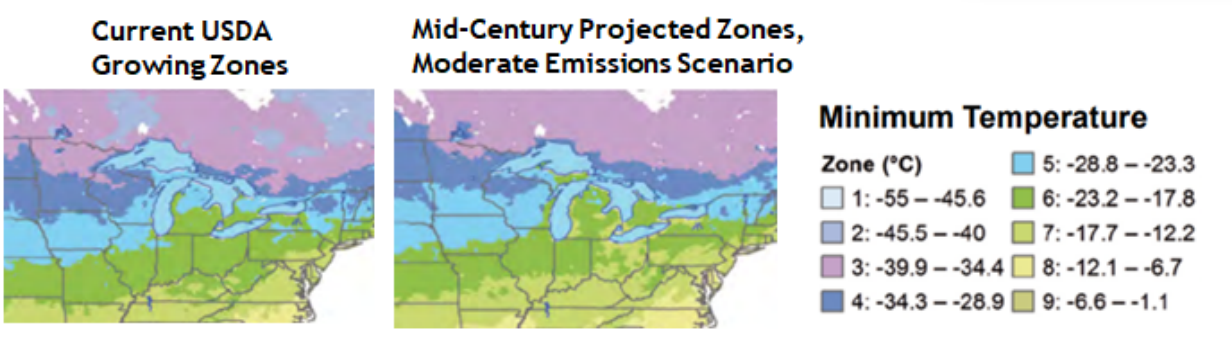
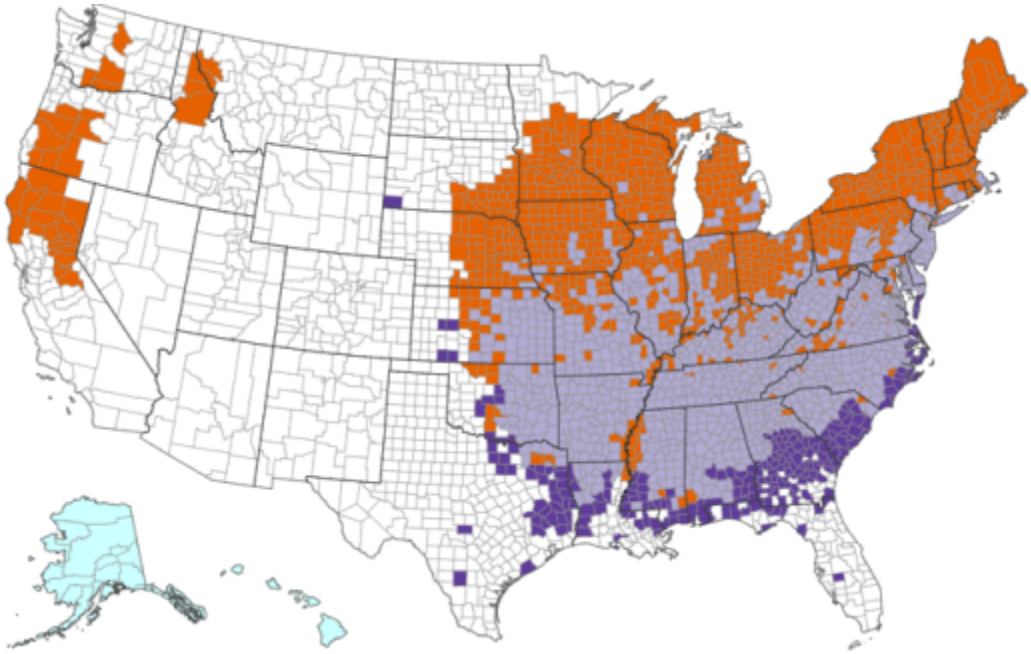


Figure 2: The map on the left shows the previous USDA Plant Hardiness Zones from 2012. The center map shows projections of Hardiness Zones mid-century under a moderate emissions scenario. The unit on the key for this image is degrees Celsius. (Images from: Matthews, S.N., Iverson, L.R., Peters, M.P., and Prasad, A.P. 2018. USDA Forest Service, Northern Research Station. Research Map NRS-9.

The Northeast RISCC team worked with EDDMapS to develop tools that help users visualize the potential mid-century (2040-2060) ranges of 896 terrestrial invasive plant species. The modeling was done using a moderate environmental change scenario (the same scenario used for the hardiness zone shift work discussed above). On the EDDMapS Range Shift Listing page, users can generate state and county level lists of species that are not currently reported in the selected jurisdiction but that are predicted to have an environmental match mid-century. In making their lists, users can choose the level of uncertainty that they are comfortable with. Selecting thirteen models generates a list with the highest degree of certainty (i.e., all thirteen models used for the project predict that the area of interest will be suitable for the listed species). Selecting one model generates a list with the lowest degree of certainty (i.e., in some cases, only one out of thirteen models predicts suitability). For a full demonstration of this tool see this recorded webinar.

Another way to access this work is through the EDDMapS distribution database. Users can search for any terrestrial invasive plant species of interest and go to the county level map view. If the species was part of the project, Future Range and Future Certainty buttons will be displayed as shown below. Remember, at this time, only terrestrial plants have been modeled.

Clicking the Future Range button will display a future range map, which shows how the current known species distribution may change in response to environmental change. As with the list-generating tool discussed above, this view allows the user customize uncertainty. The “Number of Models” setting at the top left of these maps translates to the number of models that must indicate environmental suitability in order for the map to display range expansion or range stability. The color-coding on these maps is as follows:



The future range map for sericea lespedeza (Lespedeza cuneata) shows likely areas of range expansion, stability, contraction, and unsuitability in the continental U.S. for 2040-2060. (Model Agreement = 6)

- Orange = range expansion = the species is not recorded in the county now, but at least (user selected number of models) agree that the location will be suitable for the species mid-century.
- Light purple = range stability = the species is recorded in the county now, and at least (user selected number of models) agree that the location will continue to be suitable for the species mid-century.
- Dark purple = range contraction = the species is recorded in the county now, but fewer than (user selected number of models) agree that the location will continue to be suitable for the species mid-century.
- White = unsuitability = the species is not recorded in the county now, and fewer than (user selected number of models) agree that the location will be suitable for the species mid-century.

The Future Certainty view is a heat map that shows how likely it is that the species will find a suitable environment in each county. Darker shading indicates a higher degree of model agreement. The limitation with this view compared to the Future Range view is that it does not show current distribution. Note that species with abundant distribution data tend to have better model agreement (less uncertainty) than species with relatively few data points. Species with very little distribution data were not modeled.

Map to Right: The future certainty map for sericea lespedeza (Lespedeza cuneata). The large number of georeferenced presence records for this species has contributed to relatively high model agreement and few areas of moderate or low certainty (indicated by pale or medium green shading).